

What is claimed is:

1. An image forming apparatus for stacking and thus recording component color images on a recording medium using a plurality of image forming means, while transporting the recording medium down along a transport path, comprising:

pattern recording means for recording at least two primary patterns on the recording medium using one of the plurality of image forming means and also for recording an auxiliary pattern on the recording medium using another one of the plurality of image forming means;

measurement means for measuring a displacement of the auxiliary pattern off a straight line passing through the primary patterns on the recording medium; and

adjusting means for compensating for displacements of the component color images stacked by the plurality of image forming means according to a measurement of the displacement of the auxiliary pattern.

2. The image forming apparatus as defined in claim 1, wherein:

the pattern recording means records the primary patterns and the auxiliary pattern as a set pattern image in an auxiliary scan direction in which the recording

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medium is transported and records a plurality of set pattern images arranged in the main scan direction that is perpendicular to the auxiliary scan direction;

the measurement means measures the displacement of the auxiliary pattern off the straight line passing through the primary patterns for each set pattern image; and

the adjusting means compensates for the displacements of the component color images in the main scan direction according to an average value of the displacements measured on the set pattern images.

3. The image forming apparatus as defined in claim 2, wherein:

the primary patterns are located in the set pattern image in the auxiliary scan direction and divided into two groups,

the apparatus further comprising:

position determining means for determining positions, x_m , of the primary patterns for each group according to the equation:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group,

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and n' is any given integral number,

wherein:

the measurement means averages recording positions of the primary patterns for each group to obtain an average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.

4. The image forming apparatus as defined in claim 2, wherein:

there are provided n auxiliary patterns of an identical kind in the set pattern image in the auxiliary scan direction,

the apparatus further comprising:

first position determining means for determining positions, x_s , of the n auxiliary patterns according to the equation:

$$x_s = T/n \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the n auxiliary patterns are arranged, and n' is any given integral number,

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wherein:

the measurement means measures an average value of displacements of the n auxiliary patterns off the straight line passing through the primary patterns for each recorded set pattern image; and

the adjusting means compensates for displacements of the component color images in the main scan direction according to a total average value of the average values obtained from the set pattern images.

5. The image forming apparatus as defined in claim 4, wherein:

the primary patterns are located in the set pattern image in the auxiliary scan direction and divided into two groups,

the apparatus further comprising:

second position determining means for determining positions, x_m , of the primary patterns for each group according to the equation:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group, and n' is any given integral number,

wherein:

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the measurement means averages recording positions of the primary patterns for each group to obtain an average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.

6. The image forming apparatus as defined in claim 1, wherein:

the pattern recording means records the primary patterns and the auxiliary pattern as a set pattern image in a main scan direction that is perpendicular to a direction in which the recording medium is transported and records a plurality of set pattern images arranged in an auxiliary scan direction in which the recording medium is transported;

the measurement means measures the displacement of the auxiliary pattern off the straight line passing through the primary patterns for each set pattern image; and

the adjusting means compensates for the displacements of the component color images in the auxiliary scan direction according to an average value of

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the displacements measured on the set pattern images.

7. The image forming apparatus as defined in claim 6, further comprising:

wherein:

there are provided m set pattern images,

the apparatus further comprising:

position determining means for determining positions, y, of the m set pattern images according to the equation:

$$y = T/m \times (S-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, S is a sequence in which the m set pattern images are arranged, and n' is any given integral number.

8. The image forming apparatus as defined in claim 1, wherein:

the pattern recording means records the primary patterns and the auxiliary pattern as a first set pattern image in an auxiliary scan direction in which the recording medium is transported and records the plurality of first set pattern images arranged in the main scan direction that is perpendicular to the auxiliary scan direction, as well as, records the primary patterns and

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the auxiliary pattern as a second set pattern image in the main scan direction and records a plurality of second set pattern images arranged in the auxiliary scan direction;

the measurement means measures the displacement both for each of the first set pattern images and for each of the second set pattern images; and

the adjusting means compensates for the displacements of the component color images both in the main scan direction and in the auxiliary scan direction according to an average value of the displacements measured on the first set pattern images and an average value of the displacements measured on the second set pattern images.

9. The image forming apparatus as defined in claim 8, wherein:

the primary patterns are located in a first pattern image and divided into two groups,

the apparatus further comprising:

position determining means for determining positions, x_m , of the primary patterns for each group according to the equation:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image

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carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group, and n' is any given integral number,

wherein:

the measurement means averages recording positions of the primary patterns for each group to obtain an average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.

10. The image forming apparatus as defined in claim 8, wherein:

there are provided m set pattern images,

the apparatus further comprising:

position determining means for determining positions, y, of the m set pattern images according to the equation:

$$y = T/m \times (S-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, S is a sequence in which the m set pattern images are arranged, and n' is any given integral number.

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11. The image forming apparatus as defined in claim 1,
wherein:

the auxiliary pattern is recorded between the
primary patterns.

12. The image forming apparatus as defined in claim 11,
wherein:

the pattern recording means records the primary
patterns and the auxiliary pattern as a set pattern image
in an auxiliary scan direction in which the recording
medium is transported and records a plurality of set
pattern images arranged in the main scan direction that
is perpendicular to the auxiliary scan direction;

the measurement means measures the displacement of
the auxiliary pattern off the straight line passing
through the primary patterns for each set pattern image;
and

the adjusting means compensates for the
displacements of the component color images in the main
scan direction according to an average value of the
displacements measured on the set pattern images.

13. The image forming apparatus as defined in claim 12,
wherein:

the primary patterns are located in the set pattern

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image in the auxiliary scan direction and divided into two groups,

the apparatus further comprising:

position determining means for determining positions, x_m , of the primary patterns for each group according to the equation:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group, and n' is any given integral number,

wherein:

the measurement means averages recording positions of the primary patterns for each group to obtain an average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.

14. The image forming apparatus as defined in claim 12, wherein:

there are provided n auxiliary patterns of an identical kind in the set pattern image in the auxiliary

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scan direction,

the apparatus further comprising:

position determining means for determining positions, x_s , of the n auxiliary patterns according to the equation:

$$x_s = T/n \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the n auxiliary patterns are arranged, and n' is any given integral number,

wherein:

the measurement means measures an average value of displacements of the n auxiliary patterns off the straight line passing through the primary patterns for each recorded set pattern image; and

the adjusting means compensates for displacements of the component color images in the main scan direction according to a total average value of the average values obtained from the set pattern images.

15. The image forming apparatus as defined in claim 11, wherein:

the pattern recording means records the primary patterns and the auxiliary pattern as a set pattern image in a main scan direction that is perpendicular to a

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direction in which the recording medium is transported and records a plurality of set pattern images arranged in an auxiliary scan direction in which the recording medium is transported;

the measurement means measures the displacement of the auxiliary pattern off the straight line passing through the primary patterns for each set pattern image; and

the adjusting means compensates for the displacements of the component color images in the auxiliary scan direction according to an average value of the displacements measured on the set pattern images.

16. The image forming apparatus as defined in claim 15, wherein:

there are provided m set pattern images,

the apparatus further comprising:

position determining means for determining positions, y, of the m set pattern images according to the equation:

$$y = T/m \times (S-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, S is a sequence in which the m set pattern images are arranged, and n' is any given integral number.

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17. The image forming apparatus as defined in claim 11,
wherein:

the pattern recording means records the primary patterns and the auxiliary pattern as a first set pattern image in an auxiliary scan direction in which the recording medium is transported and records the plurality of first set pattern images arranged in the main scan direction that is perpendicular to the auxiliary scan direction, as well as, records the primary patterns and the auxiliary pattern as a second set pattern image in the main scan direction and records a plurality of second set pattern images arranged in the auxiliary scan direction;

the measurement means measures the displacement both for each of the first set pattern images and for each of the second set pattern images; and

the adjusting means compensates for the displacements of the component color images both in the main scan direction and in the auxiliary scan direction according to an average value of the displacements measured on the first set pattern images and an average value of the displacements measured on the second set pattern images.

18. The image forming apparatus as defined in claim 17,

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the apparatus further comprising:

$$y = T/m \times (S-1) + n' \times T$$

19. The image forming apparatus as defined in claim 17,
wherein:

the apparatus further comprising:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group, and n' is any given integral number.

wherein:

the measurement means averages recording positions of the primary patterns for each group to obtain an average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.

20. The image forming apparatus as defined in claim 17, wherein:

there are provided n auxiliary patterns of an identical kind in the first set pattern image,

the apparatus further comprising:

first position determining means for determining positions, x_s , of the n auxiliary patterns according to the equation:

$$x_s = T/n \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the n auxiliary patterns are arranged, and n' is any given integral number,

wherein:

the measurement means measures an average value of

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displacements of the n auxiliary patterns off the straight line passing through the primary patterns for each recorded set pattern image; and

the adjusting means compensates for displacements of the component color images in the main scan direction according to a total average value of the average values obtained from the set pattern images.

21. The image forming apparatus as defined in claim 20, wherein:

the primary patterns are located in the set pattern image in the auxiliary scan direction and divided into two groups,

the apparatus further comprising:

second position determining means for determining positions, x_m , of the primary patterns for each group according to the equation:

$$x_m = T/2 \times (N-1) + n' \times T$$

where T is a length of a circumference of an image carrier in the image forming means, N is a sequence in which the primary patterns are arranged in each group, and n' is any given integral number,

wherein:

the measurement means averages recording positions of the primary patterns for each group to obtain an

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average recording position and measures the displacement of the auxiliary pattern or an average value of displacements of auxiliary patterns of an identical kind off the straight line passing through the average recording positions for each group, the measurement being repeatedly done for each set pattern image.